MATH 627B: Modern Algebra II, Spring Semester 2010

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Classes Days / Time: MW / 2:00 – 3:15 PM
Location: EBA–258 (Education and Business Administration Building), San Diego State University
Class Website: https://blackboard.sdsu.edu

Office Hours: M: 3:30 – 5:30 PM, T: 2:00 – 4:00 PM, W: Noon – 1:00 PM. In addition to that, I am in my office every weekday. I encourage you to visit me at any time. However, if you set up a time with me before hand, then you can be sure that I will be there. I *strongly* encourage you to see me if there is anything related to the course that you are unclear on or would like to know more about. I want to help you learn the material and do well in the class.

Textbook

R. B. Ash, *Abstract Algebra: The Basic Graduate Year*. Freely available at http://www.math.uiuc.edu/~r-ash/Algebra.html

Course Description, Relevance, and Learning Outcomes

Math 627B completes the algebra sequence started with 627A. It comprises: fields, including algebraic extensions and finite fields, solvable groups, Galois theory, and modules. Roughly, we will study Chapters 3, 4, 6, and Section 5.7 of our textbook, which is core material. Time-permitting, we will also study selected topics from algebraic number theory, commutative algebra, and homological algebra.

Relevance: Historically, algebra developed from our desire to solve polynomial equations via formulas involving $+, -, \times, \div$, and extraction of roots, like the well-known formula for solving a second-degree polynomial. Similar formulae were also discovered for third and forth-degree polynomials. The attempt to solve equations of higher degrees stumped mathematicians for centuries until Evariste Galois proved that such a formula does not exist. We will see how field and Galois theory play a fundamental role in this. Regarding constructions with straightedge and compass, it is possible to show via field theory that certain constructions from antiquity are impossible, e.g., squaring a circle, doubling a cube, and trisecting an arbitrary constructible angle. From the modern point of

view, finite fields play a vital role in important branches of information theory, namely, error-correcting codes and cryptography. Most algebraic structures are also important in other areas of mathematics, for example, analysis, logic, and topology.

Learning Outcomes: The course will give you a good understanding of the relationship between groups and fields and the important role played by solvable groups in Galois theory. You will also learn how to work with finite fields (computationally) and understand the structure of modules over a principal ideal domain (in particular, the main result on modules is a generalization of the fundamental theorem for finitely generated Abelian groups; it is also a generalization on the existence and uniqueness of the Jordan canonical form for matrices). At the end of the semester, you will have acquired the necessary knowledge to read papers and attend talks that make use of algebra. In other words, you will be familiar with the concepts and results in the area that are common to all professional mathematicians.

Prerequisite

Modern Algebra I (MATH 627A) or the MATH 521 sequence.

Examinations, Homework, and Grading

There will be two exams worth 300 points each and a final project worth 200 points. The project will consist of a report concerning a particular topic that you will choose from a list. This will be followed by a presentation in class. You will be free to choose topics which are not on the list as well.

Exam 1: Wednesday, March 3, in class.

Exam 2: Wednesday, April 28, in class.

Homework is an integral part of the course and it is worth 200 points. Typically you will be given one week to complete a given assignment.

In summary:

Homework	200
Tests	600
Project	200
Total	1000

The numerical points for letter grades (A, A–, B+, … ,) will be based only on the test scores and homework. Roughly, an A is above 85%, A– is above 80%, B is above 70%, C is above 60%, etc.

Feel free to work with your colleagues on the homework assignments, but remember that *copying is not permitted*. Exams are to be completed alone without the use of notes or assistance from others.

Furlough Days

Besides the days when the campus is closed, I shall not be present on the following days:

- January 26;
- February 8 and 23;
- March 9 and 26;
- April 5 and 26;
- May 6 and 19.

References for Further Reading

1. D. S. Dummit and R. M. Foote, *Abstract Algebra*, Third Edition. Wiley 2004, 1984.

2. I. N. Herstein, *Abstract Algebra*, Third Edition. Wiley, 1996.

3. T. W. Hungerford, *Algebra*. Springer-Verlag Graduate Texts in Mathematics Vol. 73, 1974.

4. T. W. Hungerford, *Abstract Algebra, an Introduction*, Second Edition. Brooks Cole, 1997. (excellent undergraduate text).

5. S. Lang, *Algebra*, Revised Third Edition. Springer-Verlag, Graduate Texts in Mathematics, Vol. 211, 2003. (classic reference).